12th ICOLD European Club Symposium
Swiss Committee on Dams 2023 75

Role of dams and reservoirs in a successful energy transition

Theme A
Dams and reservoirs for hydropower in Europe

PV Plant - New potentials in Vau i Dejes HPP, Albania

Author(s): Fatjon Shaha, Arjan Jovani

KKDM
ALBCOLD

1 Introduction

This paper presents the implementation of a photovoltaic (PV) plant on the Qyrsaq Dam in Albania, aiming to harness solar energy and explore the potential for PV plants on other dams. With abundant water and sunlight resources, Albania is an ideal location for renewable energy projects. The paper also highlights the requirements for installing PV plants on large dams, providing valuable guidelines for future endeavors.

Figure 1: View of PV Plant on the downstream face of Qyrsaqi Dam

2 Main requirement to be solved

The main requirements addressed during the design phase of the project include evaluating the project area, assessing solar radiation, selecting PV technology, determining panel dimensions and power transmission, installation method and yield estimation, environmental impact assessment and mitigation, energy system connection, sizing supporting structures, conducting static and dynamic calculations for stability, establishing control and monitoring systems, implementing protective measures, defining technical specifications, analyzing seismic and weather impacts, and addressing surface water drainage.

Figure 2: View of PV Plant in Qyrsaqi Dam from Upstream

The installation method considers structural safety, ongoing dam monitoring, and access to monitoring instruments while minimizing the impact on the dam through spacing, ventilation, panel placement, monitoring system, ease of movement, and the use of lighter materials.

3 Dam safety analyses and structural safety

A comprehensive dam safety analysis was conducted during the project preparation phase. This involved evaluating the stresses on the dam body caused by the PV panels and their foundation under normal and maximum water levels. The analysis also considered the dam's behavior and structural safety over a 50-year period, including the impact of past earthquakes. The analysis followed established design standards and informed the secure mounting of PV panels on the rock-fill dam using metal profiles and reinforced concrete foundation beams. The findings ensured the proper design and installation of the PV plant while maintaining the long-term structural integrity of the dam.

To analyze the stability, stress state, and deformations of the dam, advanced engineering Finite Element software, PLAXIS 2D, was employed under plane stress conditions. This powerful software enabled a detailed assessment of the structural behavior of the dam in response to the additional loads imposed by the PV panels. By utilizing PLAXIS 2D, engineers were able to simulate and analyze the complex interactions between the dam structure and the PV system, accurately predicting stress distribution and deformations. This analysis provided critical insights into the dam's stability and ensured that the design and installation of the PV plant were carried out in a manner that maintained the structural integrity of the dam.

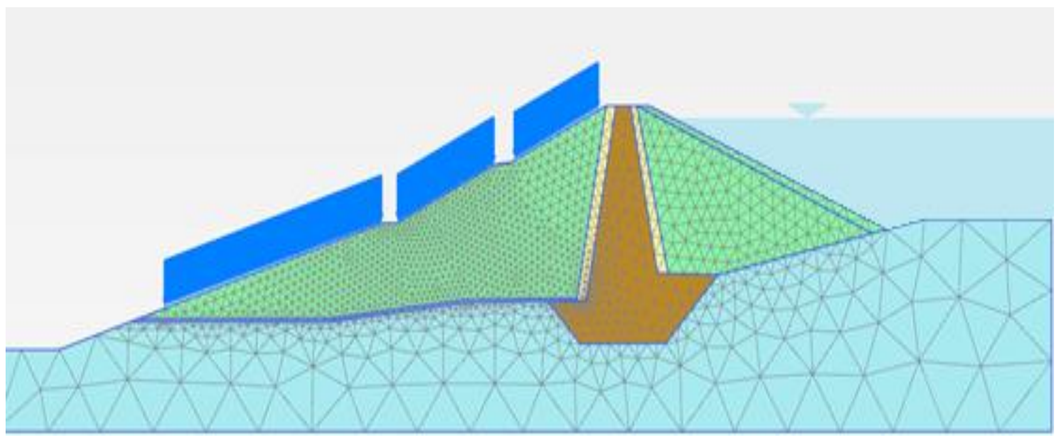

Figure 3: Mathematical model for additional load of PV plant on Qyrsaq Dam

In assessing the stability of the downstream slope of the dam, a comprehensive analysis was conducted, taking into account the saturation line between the upstream face of the dam and the filter and drainage layer beneath the downstream shell.

The results of the analysis revealed that the installation of the PV panels did not have a detrimental effect on the stability of the dam. Furthermore, the safety reliability index of the dam, determined by considering the average safety factor and a standard deviation indicator, remained within the limits specified by technical standards. This outcome confirms that the integration of the PV panels on the dam is compatible with the required safety measures and ensures the continued reliability of the dam structure.

4 References

-ALBCOLD & TCA, 2022, Main Dams in Albania, Tirana, Albania
-ERE, 2022, Annual Report on Energy Sector in Albania, Albania
-Bezati, G.J., Shaha, F., Limani, L. 2021. Study of Analysis for Dam Stability and Structural Analyses af-ter PV panels installation on Qyrsaq Dam, Albania.
-EN 50110, 2013, General Requirements for Electric installations,
-EN 50539 Part 11, 2013, Requirement and Tests for SPD of Photovoltaic installation,